

What is claimed is:

1. In a management application, a method for applying a management action to a resource, the method comprising:

- 5 receiving a selection of a resource representation in a network environment that represents a resource to which a management action is to be applied;
- applying a series of resource traversal functions to a repository containing objects representative of network resources in the network environment, the traversal functions identifying a set of action affected resources in the network environment existing along a
- 10 set of relationship paths extending to at least one storage device that have a current allocation relationship to the selected resource; and
- presenting a representation of the set of action affected resources in the network environment to a user of the management application, the representation of the set of action affected resources informing the user of resources within the storage area network
- 15 that are currently in an functional relationship with the selected resource to which a management action is to be applied and that may be affected if the management action is to be applied to the selected resource.

2. The method of claim 1 wherein applying a series of resource traversal functions

20 comprises:

- applying a going down function to the repository containing objects representative of resources to identify a set of downward resources in the network environment that have a downward allocation relationship to the selected resource, the downward allocation relationship indicating resources that the selected resource depends upon and
- 25 that are in operational use during access to data by the selected resource on a downward allocation path beginning at the selected resource and extending downward through the network environment and terminating at physical storage devices that store the data accessed by the selected resource.

30 3. The method of claim 2 wherein applying the going down function comprises:

identifying existence of a set of replicated resources in the set of downward resources, the set of replicated resources including a replicated instance of a detected replicated resource and any resources operationally related to the replicated instance of the detected replicated resource;

5 in response to identifying existence of the replicated resource:

 prompting a user to determine if the set of replicated resources are to be included in the application of the series of resource traversal functions

 receiving a replication response from the user;

10 if the replication response from the user indicates the set of replicated resources are to be included in the application of the series of resource traversal functions, then applying the series of resource traversal functions to the set of replicated resources.

15 4. The method of claim 2 wherein applying a series of resource traversal functions comprises:

 applying a going up function to the repository containing objects representative of resources to identify a set of upward resources in the network environment that have an upward allocation relationship to the selected resource, the upward allocation relationship indicating resources that depend upon operational use of resources in the set of downward resources but that exist on an upward allocation path beginning at the physical storage devices that store the data accessed by the selected resource as identified in the set of downward resources and extending upward through the network to top-level resources comprising at least one host device resource other than host device resources
25 identified in the set of downward resources.

5. The method of claim 4 wherein applying a going up function comprises:

 determining if alternate host resources exist, the alternate host resources including any host device resources of host computer systems other than a host computer system
30 containing the selected resource share data allocated on any storage device resources

identified during application of the going down function for the selected resource, and if alternate host resources exist:

prompting a user to determine if the alternate host resources are to be included in the application of the going up and closure resource

5 traversal functions;

receiving a multiple-host response from the user;

if the multiple-host response from the user indicates the alternate host resources are to be included in the application of the going up and closure resource traversal functions, then including the alternate host
10 resources in application of the going up and closure resource traversal functions.

6. The method or claim 4 wherein applying a series of resource traversal functions comprises:

15 applying a closure function to the repository containing objects representative of resources to identify a set of closure resources in the network environment that have an indirect relationship to any resources in the set of upward and downward resources resources, the set of closure resources indicating resources that would be affected by a change made to operation of resources.

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7. The method of claim 6 wherein applying a series of resource traversal functions including the going down function, the going up function and the closure function comprises:

25 identifying a collective set of action-affected resources that relate to operation of the selected resource and include the set of downward resources, the set of upward resources and the set of closure resources on data flow paths within the network environment.

8. The method of claim 7 comprising:

30 receiving a final selection of resource representations in the network environment that represent resources to which a management action is to be applied, the final selection

being made from the collective set of action-affected resources that relate to operation of the selected resource; and

applying the management action to the final selection of resource representations.

- 5 9. The method of claim 8 wherein receiving a final selection of resource representations comprises:

determining if any resources selected from the final selection of resource representations in the network environment are resources identified within the set of closure resources in the network environment, and if so, performing the operations of:

- 10 re-applying the series of resource traversal functions including the going down function, the going up function and the closure function to any selected top-level any resources selected from the final selection of resource representations in the network environment are resources identified within the set of closure resources; and

- 15 re-selecting a final selection of resource representations in the network environment that represent resources to which a management action is to be applied.

10. The method of claim 8 wherein the management application is a storage management application and the management action is deallocation of resources that operate to store data under management of the management application.

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11. The method of claim 10 wherein:

objects representative of resources in the network environment in the repository are hierarchically arranged in an order and include host objects representing host resources and storage objects representing storage resources in allocated by the host resources and where the host objects are hierarchically above the storage objects in the hierarchically arranged order; and

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wherein the selected resource representation corresponds to a host object resources; and

wherein applying the going down function comprises:

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traversing operational relationships of host objects, beginning at the selected resource host object in the repository, to identify successive

host and storage objects linked in an operational path ending at at least one storage object that is a storage device, the going down function thus identifying each host and storage resource allocated for use during access to data in the storage device object by the selected host object resource.

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12. The method of claim 11 wherein applying the going up function comprises:

identifying host objects in the repository that are:

i) operationally linked to each host and storage object identified during application of the going down function but in a direction upwards in the hierarchically
10 arranged order of objects in the repository; and

ii) that are not directly within the data flow path identified in the going down function from the selected resource host object to the storage device object, the going up function thus identifying additional objects representing resources in the network environment that may be affected by the management action upon the selected resource.

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13. The method of claim 12 wherein applying the closure function comprises:

identifying closure objects in the repository by repeatedly re-applying an operation of the going down function and going up function to the additional objects representing resources in the network environment that may be affected by the
20 management action upon the selected resource that were identified during operation of the going up function.

14. The method of claim 13 wherein hierarchically arranged host objects include a top-level host computer system, a database, a file system, a volume group, a logical volume, a
25 multipath device, a host interface device, a host port; and

wherein hierarchically arranged storage objects include a lowest-level storage device, a storage adapter, and a storage port.

15. A computer system comprising:

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a memory;

a processor;

a display;
a repository;
an interconnection mechanism coupling the memory, the processor, the display
and the repository; and

5 wherein the memory is encoded with a management application including a
resource manager application that, when executed on the processor, provides a
management process that includes a resource manager that applies a management action
to a resource by performing, in the computer system, the operations of:

receiving, via a graphical user interface on the display, a selection of a resource
10 representation in a network environment that represents a resource to which a
management action is to be applied;

applying a series of resource traversal functions to the repository containing
objects representative of network resources in the network environment, the traversal
functions identifying a set of action affected resources in the network environment
15 existing along a set of relationship paths extending to at least one storage device that have
a current allocation relationship to the selected resource; and

presenting a representation of the set of action affected resources in the network
environment to a user of the management application, the representation of the set of
action affected resources informing the user of resources within the storage area network
20 that are currently in an functional relationship with the selected resource to which a
management action is to be applied and that may be affected if the management action is
to be applied to the selected resource.

16. The computer system of claim 15 wherein when the resource manager performs the
25 operation of applying a series of resource traversal functions, the resource manager
performs the operation of:

applying a going down function to the repository containing objects representative
of resources to identify a set of downward resources in the network environment that
have a downward allocation relationship to the selected resource, the downward
30 allocation relationship indicating resources that the selected resource depends upon and
that are in operational use during access to data by the selected resource on a downward

allocation path beginning at the selected resource and extending downward through the network environment and terminating at physical storage devices that store the data accessed by the selected resource.

- 5 17. The computer system of claim 16 wherein when the resource manager performs the operation of applying the going down function, the resource manager performs the operations of:

identifying existence of a set of replicated resources in the set of downward resources, the set of replicated resources including a replicated instance of a detected
10 replicated resource and any resources operationally related to the replicated instance of the detected replicated resource;

in response to identifying existence of the replicated resource:

prompting a user to determine if the set of replicated resources are
to be included in the application of the series of resource traversal
15 functions

receiving a replication response from the user;

if the replication response from the user indicates the set of
replicated resources are to be included in the application of the series of
resource traversal functions, then applying the series of resource traversal
20 functions to the set of replicated resources.

18. The computer system of claim 16 wherein when the resource manager performs the operation of applying a series of resource traversal functions, the resource manager performs the operation of:

25 applying a going up function to the repository containing objects representative of resources to identify a set of upward resources in the network environment that have an upward allocation relationship to the selected resource, the upward allocation relationship indicating resources that depend upon operational use of resources in the set of downward resources but that exist on an upward allocation path beginning at the physical
30 storage devices that store the data accessed by the selected resource as identified in the set of downward resources and extending upward through the network to top-level

resources comprising at least one host device resource other than host device resources identified in the set of downward resources.

19. The computer system of claim 18 wherein when the resource manager performs the operation of applying a going up function, the resource manager performs the operations of:

determining if alternate host resources exist, the alternate host resources including any host device resources of host computer systems other than a host computer system containing the selected resource share data allocated on any storage device resources identified during application of the going down function for the selected resource, and if alternate host resources exist:

prompting a user to determine if the alternate host resources are to be included in the application of the going up and closure resource traversal functions;

receiving a multiple-host response from the user;

if the multiple-host response from the user indicates the alternate host resources are to be included in the application of the going up and closure resource traversal functions, then including the alternate host resources in application of the going up and closure resource traversal functions.

20. The computer system or claim 18 wherein when the resource manager performs the operation of applying a series of resource traversal function, wherein when the resource manager performs the operation of:

applying a closure function to the repository containing objects representative of resources to identify a set of closure resources in the network environment that have an indirect relationship to any resources identified by going down and going up, the set of closure resources indicating resources that would be affected by a change made to operation of original resources.

21. The computer system of claim 20 wherein when the resource manager performs the operations of applying a series of resource traversal functions including the going down function, the going up function and the closure function, the resource manager performs the operation of:

5 identifying a collective set of action-affected resources that relate to operation of the selected resource and include the set of downward resources, the set of upward resources and the set of closure resources on data flow paths within the network environment.

10 22. The computer system of claim 21 wherein the resource manager performs the operations of:

receiving a final selection of resource representations in the network environment that represent resources to which a management action is to be applied, the final selection being made from the collective set of action-affected resources that relate to operation of
15 the selected resource; and

applying the management action to the final selection of resource representations.

23. The computer system of claim 22 wherein when the resource manager performs the operation of receiving a final selection of resource representations, the resource manager
20 performs the operations of:

determining if any resources selected from the final selection of resource representations in the network environment are resources identified within the set of closure resources in the network environment, and if so, performing the operations of:

25 re-applying the series of resource traversal functions including the going down function, the going up function and the closure function to any selected top-level any resources selected from the final selection of resource representations in the network environment are resources identified within the set of closure resources; and

re-selecting a final selection of resource representations in the network environment that represent resources to which a management action is to be applied.

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24. The computer system of claim 22 wherein the management application is a storage management application and the management action is deallocation of resources that operate to store data under management of the management application.

5 25. The computer system of claim 24 wherein:

objects representative of resources in the network environment in the repository are hierarchically arranged in an order and include host objects representing host resources and storage objects representing storage resources in allocated by the host resources and where the host objects are hierarchically above the storage objects in the
10 hierarchically arranged order; and

wherein the selected resource representation corresponds to a host object resources; and

wherein when the resource manager performs the operation of applying the going down function, the resource manager performs the operation of:

15 traversing operational relationships of host objects, beginning at the selected resource host object in the repository, to identify successive host and storage objects linked in an operational path ending at at least one storage object that is a storage device, the going down function thus identifying each host and storage resource allocated for use during access
20 to data in the storage device object by the selected host object resource.

26. The computer system of claim 25 wherein when the resource manager performs the operation of applying the going up function, the resource manager performs the operation of:

25 identifying host objects in the repository that are:

i) operationally linked to each host and storage object identified during application of the going down function but in a direction upwards in the hierarchically arranged order of objects in the repository; and

ii) that are not directly within the data flow path identified in the going down
30 function from the selected resource host object to the storage device object, the going up

function thus identifying additional objects representing resources in the network environment that may be affected by the management action upon the selected resource.

27. The computer system of claim 26 wherein when the resource manager performs the operation of applying the closure function, the resource manager performs the operation of:

identifying closure objects in the repository by repeatedly re-applying an operation of the going down function and going up function to the additional objects representing resources in the network environment that may be affected by the management action upon the selected resource that were identified during operation of the going up function.

28. The computer system of claim 27 wherein hierarchically arranged host objects include a top-level host computer system, a database, a file system, a volume group, a logical volume, a multipath device, a host interface device, a host port; and

wherein hierarchically arranged storage objects include a lowest-level storage device, a storage adapter, and a storage port.

29. A computer program product having a computer-readable medium including computer program logic encoded thereon that, when executed on a computer system provides a method for applying a management action to a resource in a network by causing the computer system to perform the operations of:

receiving a selection of a resource representation in a network environment that represents a resource to which a management action is to be applied;

applying a series of resource traversal functions to a repository containing objects representative of network resources in the network environment, the traversal functions identifying a set of action affected resources in the network environment existing along a set of relationship paths extending to at least one storage device that have a current allocation relationship to the selected resource; and

presenting a representation of the set of action affected resources in the network environment to a user of the management application, the representation of the set of

action affected resources informing the user of resources within the storage area network that are currently in an functional relationship with the selected resource to which a management action is to be applied and that may be affected if the management action is to be applied to the selected resource.